

# Methodology for Distributed Electric Propulsion Aircraft Control Development with Simulation and Flight Demonstration, Phase I

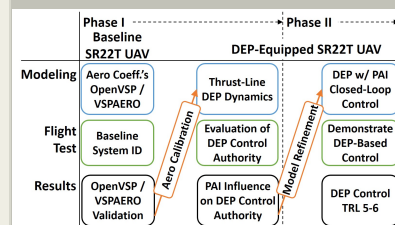
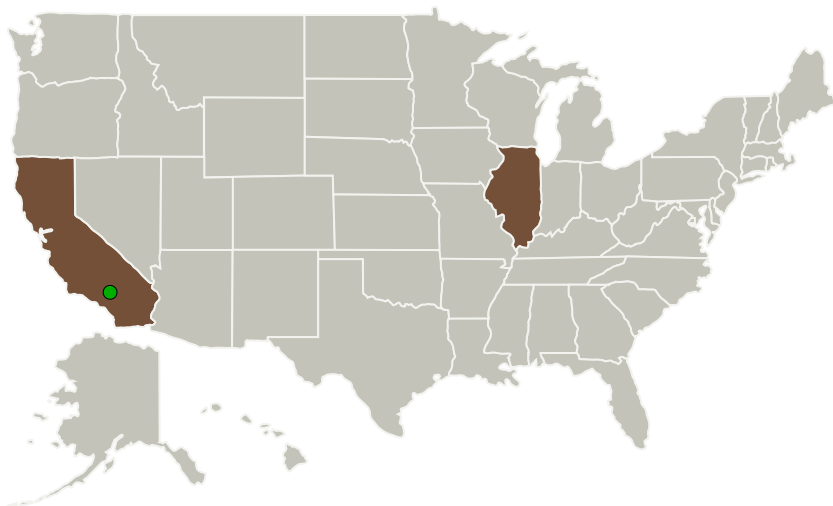
Completed Technology Project (2017 - 2018)



## Project Introduction

In the proposed STTR study, Empirical Systems Aerospace, Inc. (ESAero) and the University of Illinois at Urbana-Champaign (UIUC) will create a methodology for the development of a flight control algorithm featuring differential thrust provided by a distributed electric propulsion (DEP) system. The focal piece of the study is a dynamically scaled Cirrus SR22T UAV at UIUC, which will be modified to include multiple electrical ducted fans (EDF) arranged to exhibit strong propulsion-airframe integration (PAI) effects. Although aeropropulsive efficiency of the DEP system will be monitored, the team's goal is to establish a methodology which can be applied to any DEP aircraft regardless of how well it is designed. The study will include a combination of low-order aerodynamic simulation via OpenVSP/VSPAERO, dynamics modeling in MATLAB/Simulink, wind tunnel characterization of the EDF units, and flight testing to educate and demonstrate the flight control algorithm. During Phase I, the team will characterize the baseline vehicle as the control for the experiment and then compare measured control authority of the DEP system against a simple thrust-line dynamics model to determine the influence of PAI. Subsequent phases will develop and demonstrate closed-loop flight control using differential thrust from the DEP system.

## Primary U.S. Work Locations and Key Partners



Methodology for Distributed Electric Propulsion Aircraft Control Development with Simulation and Flight Demonstration, Phase I Briefing Chart Image

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Organizations Performing Work	Role	Type	Location
Empirical Systems Aerospace, Inc.(ESAero)	Lead Organization	Industry	Pismo Beach, California
● Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California
Board of Trustees of the University of Illinois	Supporting Organization	Academia	Champaign, Illinois

## Primary U.S. Work Locations

California	Illinois
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## Project Transitions

▶ **June 2017:** Project Start

✓ **June 2018:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140847>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Empirical Systems Aerospace, Inc. (ESAero)

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

Carlos Torrez

### Principal Investigator:

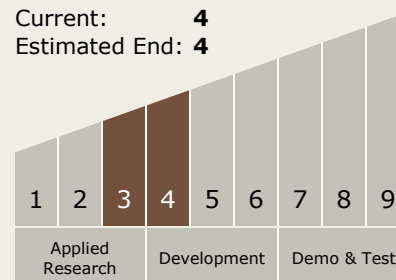
Jeffrey L Freeman

## Technology Maturity (TRL)

Start: **3**

Current: **4**

Estimated End: **4**

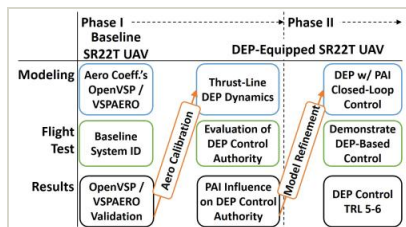


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## Images



### Briefing Chart Image

Methodology for Distributed Electric Propulsion Aircraft Control Development with Simulation and Flight Demonstration, Phase I

Briefing Chart Image

(<https://techport.nasa.gov/image/128342>)

## Technology Areas

### Primary:

- TX15 Flight Vehicle Systems
  - └ TX15.1 Aerosciences
    - └ TX15.1.6 Advanced Atmospheric Flight Vehicles

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System